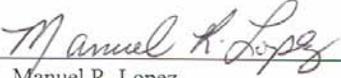
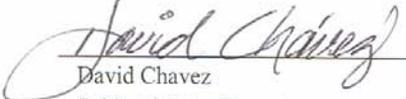
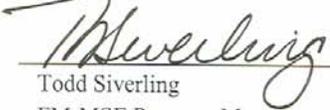
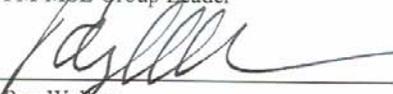


CRITERION 603

ROOFING SYSTEMS

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RECORD OF REVISIONS

Revision No.	Date	Description
0	12/05/02	Initial Issue
1	2/09/2006	This revision includes: <ul style="list-style-type: none">• The addition of a table of contents• Update references to DOE O 430.1B• Update references to DOE O 433.1• Updated references to FMD and FM-MSE• Added Subject Matter Expert (SME) to Acronyms Section 3.1 and 4.4• Changed Facility Maintenance Supervisor and Facility Manager titles to Maintenance Manager in Sections 3.2 and 4.2• Changed Group Leader title to Responsible Division Leader (RDL) on Section 4.3• Removal of Roof Seasonal Readiness Inspection short-course from section 7.1.1• Clarified paragraph on lightning protection and referenced NFPA 780 and O & M Criterion 507• Changed reference 10.3 Uniform Building Code to International Building Code and Section 3.1 Acronyms• Removed LIR reference on section 4.1.1• Removed LIR reference on section 5.1.3 and replaced with IMP300.2• Removal of LIR 301-00-02 which does not exist

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CRITERION 603**ROOFING SYSTEMS****1.0 PURPOSE**

The purpose of this Criterion is to establish the minimum requirements and best practices for operation and maintenance of roofing systems at Los Alamos National Laboratory (LANL).

This document addresses the requirements of LIR 230-05-01(Ref 10.11), "Operations and Maintenance Manual."

Implementation of this Criterion satisfies DOE Order 430.1B (Ref 10.2) for the subject equipment / system. DOE Order 430.1B (Ref 10.2) "Real Property Asset Management," Attachment 2 "Contractor Requirements Document," Paragraph 5, which in part requires UC to "...maintain real property assets in a manner that promotes operational safety, worker health, environmental compliance, property preservation and cost-effectiveness while meeting the program missions."

Compliance with DOE Order 430.1B is required by Appendix G of the UC Contract.

2.0 SCOPE

This criterion is applicable to all Laboratory roofs. There are over 5,000,000 square feet of roof area within the LANL complex. This Criterion provides guidance to operations and maintenance personnel for roof inspection, preventive maintenance, repairs, and mounting items at, or above roof level. It does not include guidance for the selection of new roofing. New roof selection criteria are identified within the LANL Engineering Manual.

3.0 ACRONYMS AND DEFINITIONS**3.1 Acronyms**

CFR	Code of Federal Regulations
DOE	Department of Energy
LIG	Laboratory Implementing Guidance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement
NMED	New Mexico Environmental Department

NRCA	National Roofing Contractors Association
O&M	Operations and Maintenance
POC	Point of Contact
PPE	Personal Protective Equipment
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
SSS	Support Services Contractor
IBC	International Building Code
UC	University of California
SME	Subject Matter Expert

3.2 Definitions

Felt. A flexible sheet manufactured by the interlocking of fibers through a combination of mechanical work, moisture, and heat, without spinning, weaving, or knitting. Roofing felts are manufactured from vegetable fibers (organic felts), glass fibers (glass-fiber felts), or polyester fibers (synthetic-fiber mats). (National Roofing Contractors Association, 1996) (Ref 10.10)

Maintenance Manager. The LANL individual responsible for the maintenance of specific Division building assets.

Flashing cements. A toweling mixture of solvent based bitumen, mineral stabilizers, and fibers. (National Roofing Contractors Association, 1996) (Ref. 10.10)

LANL Qualified Roof Inspection Personnel. Individuals trained to perform designated inspections, maintenance oversight, and minor design functions for specific roof types. Training includes safety training on specific roof hazards, roof defects recognition, materials compatibility, repair materials life expectancy, and minor details design. LANL Qualified Roof Inspection Personnel training requirements can be met by completing a nationally recognized qualified roof inspection personnel training course or LANL approved equivalency course.

Membrane Roof. A flexible or semi-flexible roof covering whose primary function is the exclusion of water.

Roof System. An assembly of interacting components designed to weatherproof, and normally to insulate a building's top surface. (National Roofing Contractors Association, 1996) (Ref. Ref. 10.10)

Service Life. Anticipated useful life of a building, building component, or building subsystem (e.g., roof system).

4.0 RESPONSIBILITIES**4.1 FM-Maintenance Support & Engineering (MSE)**

4.1.1 FM-MSE is responsible for the technical content of this Criterion and monitoring the applicability and the implementation status of this Criteria and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

4.2 Maintenance Manager

4.2.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.2.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.3 Responsible Division Leader (RDL)

4.3.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document, which are under their jurisdiction.

4.3.2 Responsible for system performance analysis and subsequent replacement or refurbishment of assigned PP&PE.

4.4 Subject Matter Expert (SME) – POC for LANL Roofing Program

The SME is responsible for providing decisions on specific technical questions regarding this criterion and fulfills the role of roofing SME.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

- 5.1.1** Roofing projects involving the removal of more than 160 square feet of regulated asbestos containing material must provide notice to New Mexico Environmental Department (NMED) at least 10 working days prior to removal. HSR-5 will prepare and submit notifications to NMED.

Basis: Laboratory Implementation Requirement LIR 404-10-01.2 (Air Quality Review) and 40CFR61.145.

- 5.1.2** Some old roofing felts and plastic cements may have been manufactured with asbestos fibers. Comply with Laboratory standards to identify, handle, penetrate, or dispose of suspect asbestos laden materials. Refer to LIR 402-570-01.1, Asbestos.
- 5.1.3** Provide for fall protection utilizing OSHA 29CFR 1910 Subpart D and IMP-300.2 (Integrated Work Management for Work Activities) (Issued 02/09/2005).

5.2 Limitations

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.).

Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 433.1 (Ref. 10.3) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order or CFR identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section.

6.1 Operations Requirements

Maintenance Managers who have warranties in effect must comply with the provisions of those warranties throughout the duration of the warranty period.

Basis: Reference 10.4, Section 1.3, recommends this action.

No further requirements beyond those stated in Section 5.2, Limitations.

6.2 Maintenance Requirements

No further requirements beyond those stated in Section 5.2, Limitations.

7.0 RECOMMENDATIONS AND GOOD PRACTICES

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on his/her unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

Inspect each roof twice annually, once in the spring and again in the fall. The inspection should include the removal of trash, debris and abandoned materials and equipment.

7.1.1 Seasonal Readiness Checks

Seasonal “readiness checks” should be conducted for each roof semiannually. The checks should include the removal of trash and debris from roof surfaces; clearing drains, gutters and scuppers of obstructions (as applicable); and identifying defects requiring maintenance, or repair by “trained maintenance personnel.” These checks should be conducted during the months of April and October each year. To facilitate consistency and to enhance the ability to evaluate a building’s changing roof conditions, facility personnel should develop a customized roof checklist for each building. As a minimum, each checklist should address the applicable points identified within the latest edition of the FMD, SEMIANNUAL ROOF CHECKLIST, form # FMD-MSE 00-M-RFC-S001, see Appendix A.

Special or unscheduled roof inspections should be conducted whenever events occur that could affect the integrity of the roof system such as; unusually high winds, hail storms, temperature extremes (cold or hot) or fires.

Basis: Reference 10.4, Section 5.0, Owner Performed Maintenance, recommends this activity.
Reference 10.9, recommends this action.
Reference 10.8, DOE-OEW, 97-42, recommends this action.

7.1.2 Access to roofs should be controlled to minimize personal injuries and roof damage caused by unauthorized personnel.

Basis: Reference 10.4, Section 7.0, recommends this action.

7.1.3 Infrared Thermography should be used periodically to inspect roofs for subsurface moisture infiltration and to guide repair efforts. Infrared Thermography frequency should be established for individual building roofs based on several factors, such as; roof slope, type of roof covering materials, roof age, type and location of roof insulation, and the consequences of potential insulation damage, or roof leaks.

Basis: Reference 10.4, Section 4.0, Roof Inspections and Reference 10.5, Section 4.0, Roof Inspections, recommends this activity.

7.1.4 Roof Top Equipment Mounting and Penetrations

With few exceptions, roofs are designed and constructed to protect buildings and their contents from the elements and airborne intrusion, *only*. The placement of equipment, experiments, or other items onto the roof’s surface frequently causes premature deterioration of the surface.

Designs and appropriate details that maintain an affected roof system’s integrity should be prepared by a “qualified roofing professional” before penetrations, equipment, experiments, or other roof mounted items can be authorized. Wood sleepers (4”x 4” beams resting directly of the roof surface to support roof mounted

items) should not be used under any circumstances. Designs and details should comply with the Laboratory's Facility Engineering Manual.

Basis: Reference 10.4, Section 7.0, Installation of New Penetrations or Equipment and Reference 10.10, The National Roofing and Waterproofing Manual, Fourth Edition, National Roofing Contractors Association, 1996.

7.1.5 Periodic Inspections

Roofs should be inspected at least once every two years by LANL "qualified roof inspection personnel." To facilitate consistency and enhance the ability to evaluate a building's changing roof conditions, inspectors should use the latest edition of form # FMD-MSE 00-M-RFI-BE003, PM Roof Inspection Form, see Appendix B.

Special roof inspections should be conducted whenever events occur that could affect the integrity of the roof system; such as unusually high winds, excessive foot traffic, maintenance or construction activities, unusual temperature extremes, hail, or fires.

Basis: Reference 10.8, DOE-OEW, 97-42, recommends this action.

7.2 Maintenance Recommendations

Maintenance Managers should develop a roof maintenance program that includes roof inspection requirements, roof repair schedules, roof drain maintenance, and efforts to minimize traffic on roofs to extend roof life.

Basis: Reference 10.8, DOE-OEW, 99-26, recommends this action.

7.2.1 Roof corrective maintenance should be initiated as soon as possible after the identification of defects.

Basis: Reference 10.4, Section 5.0, recommends this action.

7.2.2 Only craftsmen trained to service specific roof systems should be allowed to perform maintenance and repairs on those roof systems. The roof system's manufacturer should be the source of training if the manufacturer can not be identified then training should be based on National Roofing Contractors Association (NRCA) recommended practices.

Basis: Reference 10.4, Section 5.0, recommends this action.

7.2.3 Maintenance Managers who have warranties in effect should comply with the provisions of those warranties throughout the duration of the warranty period.

Basis: Reference 10.4, Section 1.3, recommends this action.

7.2.4 Lightning Protection System Reinstallation

Return all lightning protection components to their original location and configuration as soon as roofing maintenance materials have cured as per the requirements of NFPA 780 and O & M Criterion 507 - Lightning Protection Systems.

7.2.5 Traffic Patterns

Pedestrian and/or equipment traffic patterns across roofs should be identified and monitored for roof surface damage. Roof surface protection should be provided where observations indicate either actual or potential damage. Stairs and platforms should be provided where dangerous areas exist. Permanent work ladders should be installed where possible.

8.0 GUIDANCE

8.1 Operations Guidance

8.1.1 No implementing guidance available.

8.2 Maintenance Guidance

8.2.1 Provided it has been reviewed and approved by FM-MSE, an acceptable program for roof maintenance may be found in PMI 40-30-002, "Roof Maintenance and Repair Program." (Reference 10.6).

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for roofs to include, as a minimum, the parameters listed in the Table 9-1 below:

Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	ML 1	ML 2	ML 3	ML 4
Maintenance Activities				
Repair / Adjustments	X	X	X	X
PM Activities	X	X	X	X
Leaks and Locations	X	X	X	X
Equipment Problems				
Failure Dates	X	X	X	X
Failure Root Cause	X	X	X	X

Inspection Results				
Inspection Date	X	X	X	X
SSC Condition	X	X	X	X

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.15) which states; “Maintenance activities, equipment problems, and inspection and test results are documented.”

10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

- 10.1** LIR 230-05-01, Operation and Maintenance, (07/16/98).
- 10.2** International Building Code.
- 10.3** Manual for Inspection and Maintenance of Built-Up and Modified Bitumen Roof Systems: A Guide For Building Owners, National Roofing Contractors Association, 1996.
- 10.4** Manual of Roof Inspection, Maintenance, and Emergency Repair for Existing Single-Ply Roofing Systems, National Roofing Contractors Association, 1996.
- 10.5** PMI 40-30-002, “Roof Maintenance and Repair Program.”
- 10.6** DOE Order 4330.4B, Maintenance Implementation Plan.
- 10.7** DOE Operating Experience Weekly.
- 10.8** Manual of Low Slope Roof Systems, Third Edition, C.W. Griffin and Richard Fricklas, 1996.
- 10.9** The National Roofing and Waterproofing Manual, Fourth Edition, National Roofing Contractors Association, 1996.
- 10.10** LIR 230-05-01.0, Operation and Maintenance Manual.
- 10.11** DOE O 430.1A, Attachment 2 “Contractor Requirements Document” (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.
- 10.12** DOE Order 4330.4B, Maintenance Management Program, Section 3.4.9.
- 10.13** LPR 230-07-00.0; Maintenance History, Performance Criteria [2].
- 10.14** LANL- Facility Construction Manual, 16670

11.0 APPENDICES

Appendix A: Semiannual Roof Checklist, FMD-MSE 00-M-RFC-S001.

Appendix B: PM Roof Inspection Form, FMD-MSE 00-M-RFI-BE003.